

REGIONAL FISHERIES OVERVIEW

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The northern Gulf of Mexico, Gunter's fertile fisheries crescent, has traditionally been among the nation's most productive fishing waters. These rich waters annually yield approximately 2.4 billion pounds of fish valued at more than \$780 million at dockside (estimated total economic impact is \$2.34 billion). This harvest represents 40 percent of the total domestic harvest of fish. Until recent years the Gulf has boasted both the nation's largest (gulf menhaden) and most valuable (penaeid shrimp) commercial fisheries. The region also supports substantial commercial fisheries for groundfish (several species of sciaenids), coastal pelagic fishes (mostly king and Spanish mackerels), oceanic pelagic fishes (yellowfin and bluefin tuna, sharks, and swordfish), reef fish, and expanding fisheries for small pelagic fish (small coastal herrings, jacks and scombrids). The total annual commercial yield for the Gulf exceeds the combined annual landings of the New England, Mid-Atlantic, and South Atlantic regions.

The northern Gulf is also a major recreational fishing area, providing 35% (in number) of the total U.S. recreational catch. Over 20 million saltwater fishing trips occur annually in the Gulf, including major head boat and charter boat fisheries that depend upon reef fish, mackerels, tunas, and other pelagic species.

Many of the fisheries in the Gulf of Mexico are over exploited, creating management problems. Most of these and other fishery management problems are due in part to, or exacerbated by, inadequate understanding of the ability to predict recruitment (incoming year class strength).

Although there are other scientific and technical limitations, recruitment is widely regarded among fishery scientists as the major obstacle to improved prediction of future yields and simulations of the effects of different levels and strategies of fishing. Four factors determine the yield from a fishery: growth and recruitment which add to the fishable stock and natural and fishing mortality that subtract from it. Growth, natural and fishing mortality are well understood and effectively modeled. Recruitment, the process through which eggs are spawned, hatch and new individuals survive to enter the fishery, is the major contributor to changes in biomass, and it often varies by orders of magnitude. The underlying causes of recruitment variation are poorly understood, but environmental factors are believed to play the critical role during the early life stages.

Three main factors, feeding success, predation and transport, contribute to the success or failure of recruitment. Environmental features in the ocean directly influence all three, for example, by concentrating predators or prey, by transporting larvae to food concentrations and nursery grounds or good and bad predator fields. Potentially influential environmental features range in scale from small wind events, fronts, gyres, eddies, etc., to major ocean climate events and current systems. Many of these environmental features are ephemeral and difficult to detect and study. In contrast, riverine plumes like the Mississippi River discharge are easily detectable and persistent, and provide an excellent opportunity to study a factor that undoubtedly is a major influence on recruitment in the northern Gulf of Mexico.

The northern Gulf of Mexico in the vicinity of the Mississippi River is the most productive region in the Gulf of Mexico. Portions of the continental shelf affected by the river have long been noted as regions of high phytoplankton stocks and productivity. Copepod naupliar densities off the Mississippi Delta have been reported to be 28-150 l⁻¹, up to 10 times greater than densities observed off Florida to Texas. In the immediate vicinity of the discharge plume naupliar densities of up to 1000 l⁻¹ have been observed during summer.

Similarly, fish larvae are very abundant in the vicinity of the Mississippi River. Average larval fish densities around the Mississippi River discharge have been found to be up to 20 times greater than densities along Loop Current fronts in the open Gulf of Mexico. Total ichthyoplankton catches, including important species such as Spanish mackerel and yellowfin tuna, were up to 120 times more concentrated in 6-8 km wide frontal zone than in adjacent Mississippi plume and Gulf of Mexico shelf waters (Figure 11).

Several factors suggest that the Mississippi River is the ultimate source of much of this biological productivity. The river discharge is large and much of it remains on the broad shallow shelf for several months. As NECOP results have shown, river waters contain high concentrations of dissolved nutrients, and the open Gulf does not appear to be a significant source of shelf nitrogen.

Because of the high biological productivity in the vicinity of the Mississippi discharge it has been hypothesized that the plume and vicinity offer special environmental conditions that favor feeding, growth and survival of fish larvae. And that an average, larvae produced within the influence of the discharge plume recruit in higher numbers to northern Gulf of Mexico fisheries. If this hypothesis is correct, understanding which environmental factors are associated with larval fish success could lead to the ability to forecast recruitment of economically important species.

To evaluate the growth element of this hypothesis, otolith microstructure has been used to examine growth and mortality rates of fish larvae, both in relation to environmental gradients associated with the discharge plume, and in the vicinity of and away from the plume. Growth rates of king mackerel *Scomberomorus cavalla*, and Atlantic bumper, *Choroscombrus chrysurus*, were higher off the Mississippi Delta than away from the delta. Spanish mackerel, *S. maculatus*, larvae in the immediate vicinity of the discharge plume grow faster at intermediate salinities (28-31%), i.e., in the frontal zone (Figure 12). The same pattern of higher growth at intermediate salinities is also evident in larval yellowfin tuna, *Thunnus albacares*, and striped anchovy, *Anchoa hepsetus*, larvae.

However, daily instantaneous mortality rates for both king and Spanish mackerel larvae are higher in the vicinity of the discharge plume as compared to away from the plume, probably because the physical and biological factors that aggregate larval fish prey also aggregate their predators.

Figure 11. Total ichthyoplankton catch per 10 min neuston tow in Mississippi River plume, front and Gulf of Mexico shelf waters.

Figure 12. Mean growth per day for Spanish mackerel, *Scomberomorus maculatus*, larvae plotted on surface salinity. Intermediate salinities represent frontal waters, while low and high salinities represent plume and Gulf of Mexico shelf waters, respectively.

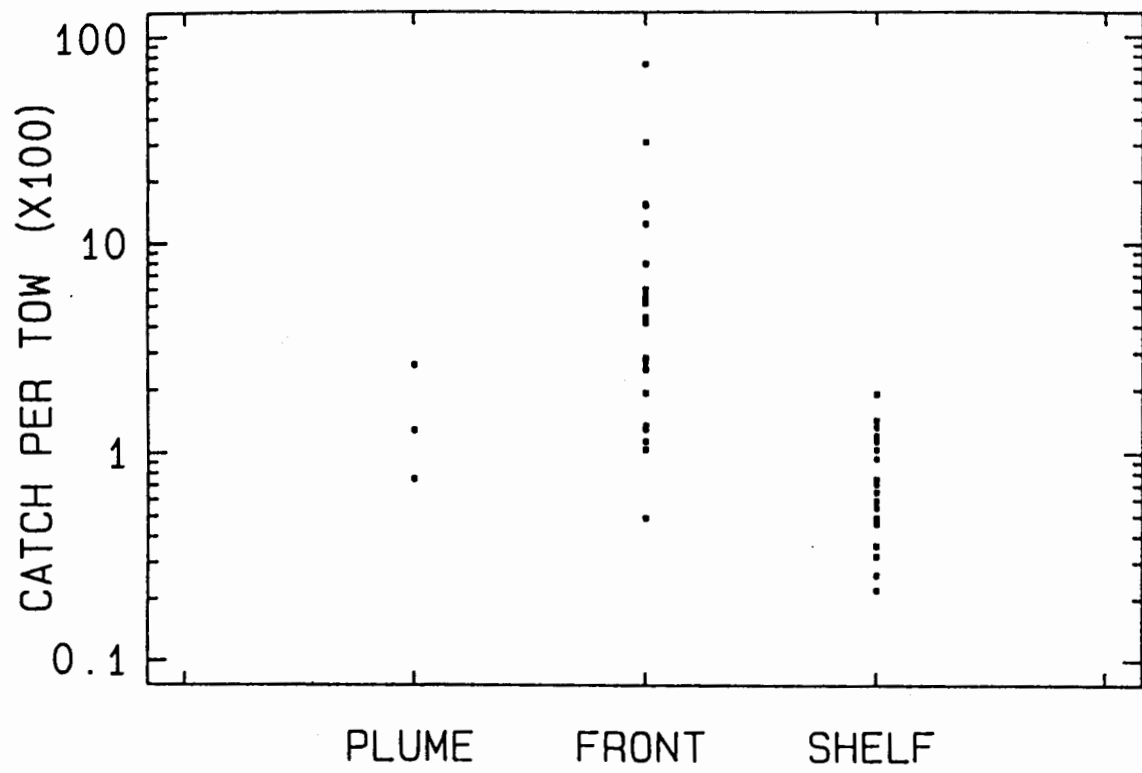


Figure 11

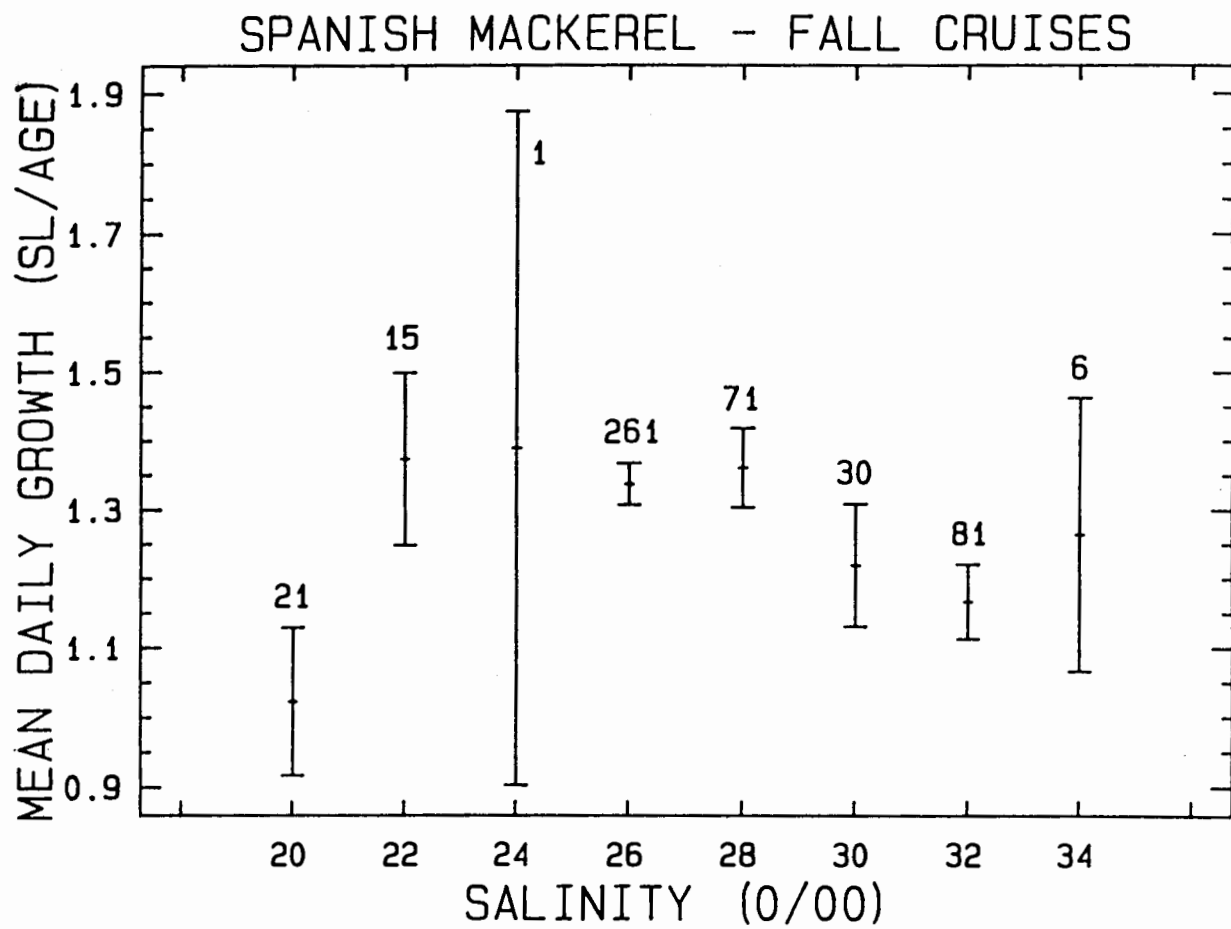


Figure 12

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